Expandable Pipe Stopper

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to a pipe stopper for inserting within, and sealing, a pipe, and a remote installation device for installing an expandable pipe stopper.

2. Description of the Related Art

[0002] Pipe stoppers are known which include arrangements wherein co-axial plates are moved towards each other by cam means to squeeze one or more radially expandable seals disposed between them, the stoppers being axially elongated to ensure their stable positioning in the pipe.

[0003] Stoppers are also known which include arrangements wherein co-axial plates are moved towards each other by pivotable cam means to squeeze a radially outwardly expanding seal disposed between them into contact with a bore of a pipe, an annular wear plate in the form of a plane washer being interposed between the cam means and the adjacent one of said co-axial plates. The wear plate is the disposed on an externally screw threaded spigot that is fixed to the centre of one of said co-axial plates and passes through a central aperture in the other of said co-axial plates. The cam means are pivotally mounted on a collar having an internal screw thread by which the collar is positioned on the spigot. This known arrangement has the disadvantages of the cam means when operated tend to force the co-axial plates towards each other in a non-parallel manner; and also push the wear plate sideways into engagements with the screw threads on the spigots, causing jamming of the desired squeezing action of the cam means.

[0004] Pipe stoppers may be used in locations which are not easily accessed. For example, pipe stoppers are used for stopping pipes

emerging into manholes in sewers. This may require a person inserting the pipe stopper to undertake specialist confined spaces training and take specified precautions to enter the manhole and insert the pipe stopper.

Brief Summary of the Invention

[0005] According to a first aspect of the present invention there is provided a pipe stopper for inserting within a pipe comprising: two rigid circular plates; an outwardly-expandable flexible seal located between peripheral surfaces of the plates; a projection rigidly secured to or integral with a first of the plates and extending slideably through an aperture defined by the second plate; a lever pivotable about an axis through the projection; cam means rigidly secured to or integral with the lever such that said lever is pivotable between a first orientation in which the flexible seal is relatively undistorted and a second orientation in which the cam means force the plates towards each other so as to axially compress and radially expand the seal for engaging with sealing contact with a wall of a pipe; and a member rigidly secured to or integral with part of a remote peripheral surface of one of the plates, said member extending from the plate such that when the pipe stopper is located within a pipe said member provides a reactive force to tilting of the pipe stopper from its operative position.

[0006] Thus, the pipe stopper though not axially elongated can be stably secured in its operative position.

[0007] According to a second aspect of the present invention, there is provided an expandable pipe stopper for inserting within a pipe comprising: two rigid co-axial circular plates; an outwardly-expandable annular flexible seal located between adjacent peripheral surfaces of the plates; a projection rigidly secured to or integral with a first one of said plates and extending slideably through an aperture defined by the second one of said plates; a collar connected to the projection; a lever pivotally mounted on the collar; and cam means fixed to the lever; wherein said lever is pivotable

between a first position in which the flexible seal is relatively undistorted and a second position in which the cam means force the plates relatively towards each other so as to compress the seal causing it to radially expand, and said lever is pivotable about an axis through the collar such that said axis is offset from the centre-line of the projection.

[0008] In a third aspect of the present invention there is provided a pipe stopper comprising: a pair of co-axial plates; a flexible seal located between the plates, said seal being configured to radially expand for sealing a pipe; a cam configured to act on one of the plates to bring said plates together to radially expand the flexible seal; and a pivotally mounted lever rigidly attached to or integral with said cam; and an elongate handle pivotally attached to said lever at a position remote from said cam, such that said lever is operable by applying a force along said handle.

[0009] In a fourth aspect of the present invention there is provided a remote installation device for an expandable pipe stopper comprising: an arm configured to be rigidly attached to a lever of a pipe stopper; an elongate handle connected to said arm by a hinging mechanism; and a stopping means which prevents the angle between the handle and the member increasing beyond a predetermined value.

[0010] In a fifth aspect of the present invention there is provided a conversion kit for an expandable pipe stopper for inserting within a pipe comprising: a collar having a screw-threaded hole configured to be connected to a screw-threaded projection on a pipe stopper; a lever pivotally mounted on the collar such that it is pivotable about an axis through the collar; cam means fixed to the lever; and a wear plate defining an aperture configured to fit around the projection of a pipe stopper, wherein said lever is pivotable between a first position and a second position in which the cam means applies force to the wear plate to radially expand the flexible seal, and said lever defines a aperture remote from said axis through the collar, said aperture being configured to receive a rope for

pulling the lever from said second position to said first position.

Brief Description of the Several Views of the Drawings

[0011] *Figure 1* shows *a* perspective view of a pipe stopper **101** configured to be inserted within, and to seal, a pipe;

[0012] *Figure 2* shows plan view of the stopper of Figure **1**;

[0013] *Figure 3* shows the pipe stopper **101** inserted within a pipe **301**;

[0014] *Figure 4* shows the pipe stopper **101** with its lever **108** in the second position to seal the pipe;

[0015] *Figure 5* shows three of the main components of the pipe stopper **101** of Figure **1**;

[0016] *Figure 6* shows the pipe stopper **101** partially assembled;

[0017] *Figure 7* shows the pipe stopper **101** with the heads **601** of pivot pins **600** partially inserted into recesses **502** and the eccentric portions **602** partially inserted into the cranked slots;

[0018] *Figures 8A, 8B and 8C* show a schematic representation of the projection **105** and the pivot pins illustrating the function of the eccentricity of the eccentric portion **602**;

[0019] *Figure 9* shows an alternative pipe stopper **901**;

[0020] *Figure 10* shows a perspective view of another expandable pipe stopper **1001**;

[0021] *Figure 11* shows a side view of the pipe stopper of *Figure 10* with its lever in a first position;

[0022] *Figure 12* provides a side view of the pipe stopper of *Figure 10* with its lever in a second position;

[0023] *Figure 13* shows the wear plate **1021**, the lever **1008** and the collar **1006** from the pipe stopper of Figure **10**;

[0024] *Figure 14* provides a perspective view of the underside of the collar and contacting member unit **1320**;

[0025] *Figure 15* shows an alternative conversion kit **1500** for an

expandable pipe stopper;

[0026] *Figure 16* shows a remote installation device **1601** with the pipe stopper **101** from Figure **1**;

[0027] *Figure 17A and 17B* provide a side view and rear view of the lower parts of the remote installation device **1601** and the pipe stopper **101**;

[0028] *Figure 18* shows the two parts **1708** and **1709** of the socket member from *Figure 17A* in further detail;

[0029] *Figure 19* shows the pipe stopper **101** being lowered into a manhole **1901** of a sewer by means of the remote installation device **1601**;

[0030] *Figure 20* shows the lower part of the remote installation device **1601** with the pipe stopper **101** inserted into the end of a pipe **1903**;

[0031] *Figure 21* shows the pipe stopper **101** and remote installation device **1601** with the seal **104** radially expanded against the pipe wall;

[0032] *Figures 22A and 22B* show a side view and a rear view of an alternative pipe stopper **2201**.

Best Mode for Carrying Out the Invention

Figures 1 and 2

[0033] A perspective view of a pipe stopper **101** configured to be inserted within, and to seal, a pipe is provided by *Figure 1*, while *Figure 2* provides a plan view of the stopper **101**. The stopper **101** includes two rigid co-axial plates, a front plate **102** and a rear plate **103**, of substantially the same diameter and an outwardly expandable annular flexible seal **104** positioned between adjacent peripheral surfaces of the plates **102** and **103**. A single central axially-directed projection **105** extends from the plate **102** to which it is rigidly attached. The projection extends slideably through an aligned central aperture in plate **103**. The projection **105** has an outer wall **201** that is non-cylindrical in shape and the aperture is shaped to provide a close sliding fit around said wall. Due to the non-cylindrical shape of the projection, it is unable to rotate within the aperture, and therefore provides a

means of preventing relative rotation of the two plates **102** and **103**.

[0034] The projection **105** has an axial bore (indicated by dashed lines **306** in *Figure 3*) and a screw-threaded end **106** remote from the plate **102** to allow the connection of a nipple (not shown) to enable pressure-testing of a pipe to be effected, or an end cap **107** to effect sealing.

[0035] A bifurcated lever **108** is pivotally mounted on the projection **105**, such that it is pivotal about an axis passing through the projection perpendicular to its direction of extension from plate **102**. The lever has a pair of arms **202** each of which have cam parts **109** at one end and a handle **110** which connects the arms **202** at their other end. The lever **108** is shown in a first position in which the cam exerts little pressure on the rear plate **103** and consequently the flexible seal **104** is not deformed. The lever is pivotable to a second position such that a different part of a cam surface **111** on the cam portions **109** acts upon the plate **103** to force the two plates closer together thereby compressing the flexible seal **104** such that it expands radially.

[0036] The stopper **101** also includes a contacting member **112** that is rigidly secured to a peripheral surface of the rear plate **103**. The contacting member extends upwards from the plane of the rear plate **103** away from the front plate **102**, and has a curved outer surface **203** which has a radius of curvature of substantially the same diameter as a pipe diameter which the stopper is configured to seal.

Figures 3 and 4

[0037] The operation of the pipe stopper **101** is illustrated by *Figures 3* and *4*. *Figure 3* shows the pipe stopper inserted within a pipe **301**, without its screw-cap **107** fitted.

[0038] The pipe in this example has an internal diameter of four inches, and the pipe stopper is dimensioned to fit with this size of pipe. However, it should be understood that other sizes of the pipe stopper are configured to

fit other diameters of pipes. Typically, the end of pipe **301** is in communication with a manhole **302** in a sewerage system.

[0039] The pipe stopper is manually positioned within the end of pipe **301** while the lever **108** is in the first orientation, such that a first portion **304** of cam surface **111** is in contact with the rear plate **103**. Consequently, cam portions **109** are applying little pressure to plate **103**, the flexible seal **104** is not radially expanded and the stopper **101** can be easily positioned.

[0040] Having positioned the pipe stopper **101** in the pipe with the plates **102** and **103** perpendicular to the pipe's bore, the lever **108** is then manually rotated in direction of arrow **303** to bring the lever **108** to a second position such that a second portion **305** of the cam surface **111** contacts the rear plate **103**.

[0041] The pipe stopper **101** is shown in *Figure 4* with the lever **108** in the second position. The cam portions **109** are configured such that the distance between the second portion **305** of the cam surface **111** to the pivot axis of the lever is larger than the distance between the first portion **304** to the pivot axis. Consequently, the cam **109** pushes against plate **103** bringing it closer to plate **102**, thereby axially compressing and radially expanding the flexible seal **104**. The flexible seal expands until it meets the wall of the pipe **301** and forms a seal.

[0042] During rotation of the lever **109** to seal the pipe **301**, the pipe stopper tends to tilt out of position such that the plates are no longer perpendicular to the bore of the pipe. However, the contacting member **112** tends to be brought into contact with the pipe's inner surface, such that the pipe acts on the contacting member **112** to stop the tilting. Thus, the contacting member **112** provides a reactive force to tilting of the pipe stopper during the pipe sealing process.

[0043] It has also been found that failure of previous pipe stoppers occurs when minor leakage at the weakest point causes the stopper to tilt, and that the provision of the contact member **112** increases the resisting of tilting in

these circumstances, so as to render the stopper capable of withstanding up to twice the pressure than conventional stoppers.

Figure 5

[0044] The method of manufacture and further features of the pipe stopper **101** are illustrated by *Figures 5* to **7**. Three of the main components of the pipe stopper **101** of Figure **1** are shown in Figure **5**. The projection **105** and the front plate **102** are moulded as a single unit in a rigid plastics material, such as nylon, that is suitable for use in a sewerage system. The rear plate **103** and the contacting member **112** are also moulded as a single unit, from the same material. The flexible seal **104** is a ring moulded from rubber, or other similarly flexible and resilient material, such as a silicone rubber. The inner surface **501** of the seal **104** has a concave shape facilitating the radial expansion when axially compressed.

[0045] The projection **105** has two similar recesses **502** extending from one of its faces **503**. Each of two opposing faces **505** of the projection **105** define a cranked slot **504** which communicates with a respective one on the recesses. The recesses and slots are configured to receive pivot pins of the lever as will be later described.

[0046] The plate **103** has raised portions **506** and **507** on opposing sides of the aperture **509**. The raised portions **506** and **507** provide an extended wall **508** to face the projection **105** when the stopper is assembled. Thus the raised portions acting on the projection resist a relative movement between the plates **102** and **103** that would cause them to become non-parallel.

[0047] The plate **102** has a seat **510** at its periphery, configured to receive one sides of the flexible seal **104**, and plate **103** has a similar seat **512** at its periphery, configured to receive the other side of said seal.

[0048] The first step in the assembly process is to bring the three components shown in *Figure 5* together, for instance by positioning the seal

104 on the seat **510** of plate **102**, sliding projection **105** through the aperture **509** of plate **103** until the seal **104** is positioned on seal **512**.

Figure 6

[0049] The pipe stopper **101** is shown partially assembled in *Figure 6*. The next step in the manufacture of the pipe stopper is to mount the lever **108** on the projection **105**. A pivot pin **600** extends inwardly from each arm **202** of the lever **108**. The pivot pins have a relatively large cylindrical head **601** connected to the arm by an eccentric portion **602**. The eccentric portion **602** has the shape of a cylinder, which is smaller than and co-axial with the head **601**, but which has a flat side **603**. The lever **108** and pivot pins **600** are moulded as a single unit from a rigid plastics material, such as nylon. In this example, the handle is provided with a rubber sleeve to assist manual manipulation.

[0050] Having brought the two plates **102** and **103** and the flexible seal together, as described with reference to *Figure 5*, pressure is applied to plates **102** and **103** to force them together, such that raised portion **507** clears the recesses **502** in the projection **105**, as shown in Figure **6**.

[0051] The heads **601** of pivot pins **600** are then located within a respective recess **502** such that the flat sides **603** are adjacent the upper edges **604** of the cranked slots **504**.

Figure 7

[0052] The pipe stopper **101** is shown in *Figure 7* with the heads **601** of pivot pins **600** partially inserted into recesses **502** and the eccentric portions **602** partially inserted into the cranked slots.

[0053] Due to the eccentricity of the eccentric portions **602** caused by their flat surfaces **603**, the lever **108** can only be mounted on the projection **105** in a particular, third, orientation. This third orientation is different to the first and second operational orientations and falls outside of the operative

orientations of the lever **108**.

[0054] To complete the process of locating the lever **108**, the pivot pins **600** are pushed along the slots until their heads **601** come to the end of the recess **502**. The lever **108** is then rotated round through the second operative orientation to the first operative orientation.

[0055] Fitting the plastic moulded screw-cap **107** then completes the assembly process to produce the pipe stopper as shown in Figure **1**.

Figure 8

[0056] A schematic representation of the projection **105** and the pivot pins is provided in each of *Figures 8A, 8B and 8C*, which illustrate the function of the eccentricity of the eccentric portion **602**. The pivot pin **600** is shown in the third orientation in *Figure 8A*, such that the head **601** is able to slide through recess **502** while eccentric portion **602** is able to slide through cranked slot **504**. The pivot pin **600** is shown in *Figures 8B and 8C* in the second orientation and first orientation respectively. In each of these two orientations and all orientations in between, the eccentric portion is able to pivot within a widened part of the cranked slot, but due to the eccentric nature of the eccentric portion it is unable to slide along said slot. Therefore, the eccentric portion in combination with the cranked slot provide a means of maintaining location of the pivot pins **600** within the projection **105**.

Figure 9

[0057] An alternative pipe stopper **901** is shown in *Figure 9*. Pipe stopper **901** is like pipe stopper **101** in that it has a pair of co-axial rigid plates **902** and **903**, and a flexible seal **904** disposed between adjacent peripheral surfaces of the two plates.

[0058] A pair of projections **905** are rigidly attached to and extend perpendicularly from the plate **902**, each passing through a respective

aperture **906** defined by plate **903**. A pivot pin **907** is securely fitted within aligned holes in the projections **905**. The pivot pin **907** also passes through a lever **908** disposed between the two projections **905**. The lever **908** has an integrally formed cam portion **909** defining a cam surface **911** which acts upon the plate **903**. The cam surface has a first part **912** relatively near to the pivot pin **907** and a second part **913** relatively distance from the pivot pin. Consequently, the lever is pivotable from the first position, shown in *Figure 9* to a second position in which the cam surface second part **913** acts upon the plate **903** to bring the two plates closer together, and axially compress and radially expand the flexible seal **904**.

[0059] Like the pipe stopper **101**, pipe stopper **901** has a contacting member **914** which extends from one of the two plates, away from the other plate, but in the case of contacting member **914** it is mounted on the same plate as the projections. Thus, because it is not close to the lever **908** more space is provided for manual manipulation of the lever **908**.

[0060] Both the pipe stopper **101** and pipe stopper **901** have a fixed distance between the front plate and the lever's pivot axis. Consequently, the degree of radial expansion of the flexible seal is controlled.

Figures 10, 11 and 12

[0061] A perspective view of another expandable pipe stopper **1001** is shown in *Figure 10*, while side views of said stopper are shown in Figures **11** and **12**. The pipe stopper **1001** includes a pair of rigid co-axial circular plates **1102** and **1003**, having a centre line **1140**. A projection **1005** is rigidly attached to, and extends axially from, a first of said plates **1102**, and extends slideably through an aligned central aperture defined by the second of said plates **1003**. A flexible seal **1004** is located between adjacent peripheral surfaces of the two plates **1003** and **1102**. A step **1160** near the edge of each plate defines a seat to maintain the position of the seal **1004**.

[0062] The projection has a screw-thread on its outer cylindrical surface and a bore providing communication between one side of the pipe stopper **1001** and the other. Thus in use, a screw-cap is applied to the end of the projection to seal it or a nipple may be screwed on for the purposes of performing pressure tests on a pipe.

[0063] The stopper **1001** also includes a collar **1006** having hole containing a screw-thread configured to mate with the thread of the projection. Thus, the collar **1006** is attached to the projection **1005** by said screw-threads, and its position along the projection is adjustable.

[0064] A contacting member **1012** is rigidly attached to the collar and extends from the collar away from the plates **1102** and **1003**. Like the contacting member **112** of pipe stopper **101**, contacting member **1012** is adapted to contact a bore of a pipe so as to provide a reactive force to tilting of the stopper out of its operative position perpendicular to the axis of the pipe.

[0065] A lever **1008** is pivotally mounted on the collar **1006** such that it pivots about an axis **1150** extending parallel with the plates **1003** and **1102**. The lever **1008** is substantially the same as lever **108** of the cam stopper of Figure **1**, and, consequently, it has a bifurcated structure with a cam portion **1009** at one end of each of its arms **1020** and a handle **1022** at the opposite end. The cam portions **1009** define a cam surface **1111** having a first part **1114** that is relatively near to the axis **1150** of rotation of the lever, and a second part **1115** that is relatively distant from the axis.

[0066] The pipe stopper **1001** also includes a wear plate **1021** defining an aperture through which the projection **1005** passes; the wear plate being located between the collar **1006** and the rear plate **1003**.

[0067] The manner of operation of the pipe stopper **1001** is similar to that of pipe stopper **101**, except that the cam portions **1009** act upon the wear plate **1021** which consequently acts upon the rear plate **1003**. Thus, when the lever is in a first orientation as shown in Figure **11**, the cam portions

apply relatively little pressure to the cam plate **1021**. When the lever **1008** is rotated to a second orientation, such that the second part **1115** of cam surface **1111** acts upon the wear plate **1021**, the wear plate is forced away from the collar and forces the plates **1102** and **1003** closer together, thereby axially compressing, and radially expanding, the flexible seal **1004**.

[0068] The pipe stopper **1001** is shown with the lever **1008** in the second orientation and with the flexible seal **1004** radially expanded in Figure **12**. It will be understood that in use, when the pipe stopper is located in the end of a pipe the expanded flexible seal presses against the internal surface of the pipe to effect a seal.

[0069] When the lever **1008** is in the first orientation, as shown in *Figure 11*, with relatively little pressure applied to the seal, the plates **1102** and **1003** are parallel. During operation, as the lever **1008** is rotated from the first position through to the second position, there is a generally increasing normal force applied by the cam portions **1009** on the wear plate **1021**. This normal force moves forwards and then backwards over the wear plate as different parts of the cam surface **1111** act upon it. Furthermore, there is a corresponding frictional force between the cam surface and the wear plate which tends to drag the wear plate backwards as the lever is actuated. The combination of these forces tends to cause the rear plate **1003** to be moved such that it is no longer parallel with the front plate **1102**. However, to avoid this effect, the axis **1150** of the pivot of the lever is offset from the centre-line **1140** of the plates. Due to the offset disposition of axis **1150** the action of the cam portions **1109** on the wear plates is applied generally closer to the centre-line **1140** of the wear plate **1021** than would be the case if the axis were not offset. Consequently, the plates remain parallel during lever actuation.

[0070] By way of example, on a pipe stopper configured for use in pipe diameter of six inches, the pivotal axis is offset from the centre-line by one eighth to three eighths of an inch (three millimetres to nine millimetres).

[0071] The pipe stopper **1001** may be produced from a conventional pipe stopper that has a nut for applying the pressure to the rear plate. To convert such a pipe stopper to the pipe stopper of Figure **10**, the nut is removed and replaced by the wear plate **1021**, collar **1006** and lever **1008**. Conventional pipe stoppers have a variety of surface configurations on their rear plate, and as shown in Figure **11**, the surface may be convex. The wear plate is provided with several concentric ridges **1122** on its surface facing the rear plate which allow the location of the wear plate to be stable even when the adjacent surface of the rear plate is convex. The concentric ridges also have the effect of increasing the friction between the wear plate and the rear plate and thereby resist sideways movement of the wear plate when the lever is actuated.

[0072] In addition, the wear plate **1021** is provided with a pair of recesses **1123** configured to mate with protrusions (not shown) on the surface of the rear plate **1003**.

[0073] In an alternative embodiment to that of Figure **10**, the collar is rigidly secured to the projection.

[0074] In a further alternative embodiment to that of Figure **10**, the screw thread is omitted from the projection and the collar is secured to the projection by means of a pin selectively engageable in a diametrical hole in the collar and one of a series of axially spaced holes in the projection.

[0075] In another embodiment the wear plate is provided with diametrically-opposed projections for engagement with mating recesses in the rear plate **1003**.

Figure 13

[0076] The wear plate **1021**, the lever **1008** and the collar **1006** from the pipe stopper of *Figure 10*, are shown separated in *Figure 13*. The wear plate has a raised rim **1301** around its central aperture **1302** that is configured to fit closely within a recess (shown in Figure 14) in the

underside of the collar **1006**. This provides a degree of resistance to the effects of the above mentioned frictional forces when the lever is first actuated. The internal wall of the wear plate **1021** which defines the aperture **1302** is of sufficient length so as to extend across several screw threads on the projection **1005**. This prevents the wear plate engaging with the screw thread and causing jamming, in the event that the wear plate moves sideways during operation.

[0077] As mentioned above, the lever **1008** is substantially the same as lever **108** of pipe stopper **101**. Thus lever **1008**, cam portions **1009**, and inwardly extending pivot pins **1310** are moulded as a single unit in a rigid plastics material, such as nylon. The pivot pins have a relatively large diameter cylindrical head **1311** connected to the arms **1020** of the lever by eccentric portions **1312**. The eccentric portions being of a generally cylindrical shape with a flat side.

[0078] The collar is provided with a pair of recesses **1321** extending upwards from its underside and a respective pair of cranked slots **1322** which extend generally upwards along opposing side faces of the collar. The cranked slots **1322** communicate with the recesses **1321**, and, like the recesses and cranked slot of the projection **105**, they are configured to receive the heads **1311** and eccentric portions **1312** of pivot pins **1310**. The cranked slots **1322** and recesses **1321** are also configured such that the lever **1008** has to be in a third, non-operational, orientation for the pivot pins to be inserted and then rotated through the second operational orientation to the first operational orientation before the collar is screwed onto the projection to produce the pipe stopper **1001** as shown in Figure 10.

[0079] The collar **1006** and the contacting member **1012** are moulded as a single unit **1320**, in a rigid plastics material, such as nylon.

Figure 14

[0080] A perspective view of the underside of the collar and contacting member unit **1320** is shown in *Figure 14*. The unit **1320** comprises an outer shell **1401** and a matrix of webbing **1402**. During operation, the contacting member **1012** receives a reaction force from the pipe to prevent the pipe stopper from tilting. To perform this function effectively the unit **1320** must be sufficiently rigid such that it does not deform under the reaction force, otherwise the plates of the pipe stopper could tilt. It has been found that the matrix of webbing **1402** provides the nylon unit **1320** with the required rigidity.

[0081] The underside of the collar **1006** also defines a recess **1403** around the periphery of the threaded hole **1404** which is configured to receive the raised rim **1301** of the wear plate **1021**.

[0082] In an alternative embodiment the collar and contacting member are separate elements which are rigidly secured together.

Figure 15

[0083] An alternative conversion kit **1500** for an expandable pipe stopper is shown in *Figure 15*. The kit includes a wear plate having a central circular aperture (not shown) and an elongate handle **1502** rigidly attached to the wear plate. The kit also includes a collar **1503** having a screw-threaded hole configured to mate with a screw-threaded projection on a conventional expandable pipe stopper. A lever **1504** comprising a pair of arms **1505** is rigidly attached at one end of each arm to a respective cam plate **1506**, the cam plates being, in turn, pivotally attached to the collar **1503**. The lever **1504** has a handle **1507** joining the ends of the arms remote from the cam plates, and a retaining member **1508** rigidly secured between the two arms parallel to the lever handle **1507**.

[0084] To convert a conventional pipe stopper, the nut on the pipe stopper is removed, the threaded projection on the pipe stopper is passed through the central aperture of the wear plate **1501** and the collar is then screwed

onto said projection.

[0085] The use and operation of a pipe stopper fitted with such a conversion kit is similar to those described above. Thus, typically the pipe to be stopped will have an end which is located within a manhole of a sewerage system. The pipe stopper is manually located within the end of a pipe and the lever actuated such that the cam means act on the wear plate which in turn acts on a rear plate of the pipe stopper. A flexible seal sandwiched between the rear plate and a front plate is consequently axially compressed causing it to radially expand against the wall of the pipe.

[0086] When the pipe stopper is to be removed from the pipe, it is preferable for the user to pass one end of a rope through the aperture formed by the handle **1507**, the arms **1505** of the lever and the retaining member **1508**, and to tie it to the handle. Then, climb out of the manhole with the other end of the rope. The rope can then be pulled, to de-activate the pipe stopper and remove it from the pipe. When the rope is pulled the angle of the rope relative to the arms **1505** is such that the rope has a tendency to ride up the arms towards the pivot. However, the retaining member **1508** ensures that the rope remains at the handle end of the lever **1504** so that the rope provides an effective turning force on the lever.

[0087] It should be noted that levers with retaining members could be used on the pipe stoppers of *Figures 1 and 10*.

Figure 16

[0088] A remote installation device **1601** is shown with the pipe stopper **101** in *Figure 16*. The remote installation device **1601** comprises a lever extension arm **1602** pivotally connected to an elongate handle **1603**. The elongate handle **1603** comprises three sections arranged to fold up telescopically to the folded configuration shown in Figure **16**. The handle **1603** is provided with securing devices **1604** and **1605** which, when locked, fix the relative positions of the sections. Thus, to adjust the length of the

handle **1603**, the securing devices **1604** and/or **1605** are released, the length adjusted, and then the securing devices re-locked.

[0089] The handle **1603** comprises an Extender Telescopic System, as produced by Exel Industries of Finland, received into a hinge member **1606** which forms part of a hinge mechanism attaching the handle **1603** to the lever extension member **1602**.

[0090] In alternative embodiments the handle is non-telescopic, being made from a single length of aluminium or fibre glass reinforced tube. In a further alternative embodiment the handle is telscopically folding but has just two sections rather than three.

Figures 17A and 17B

[0091] A side view of the lower parts of the remote installation device **1601** and the pipe stopper **101** is shown in *Figure 17A* with a corresponding rear view shown in *Figure 17* B.

[0092] The lever extension member **1602** includes a socket **1701** at one end which is configured to receive and retain the handle **110** and adjacent parts of the arms **202** of lever **108** of pipe stopper **101**. The socket **1701** is provided with a pair of holes **1710** through which fasteners, such as bolts or clips, may be inserted to ensure that the pipe stopper is securely retained by the socket. At its opposite end, lever extension member **1602** is connected to the lower end of the handle **1603** by a pivot pin **1702**.

[0093] The hinge member **1606**, at the lower end of the elongate handle **1603**, has a flat surface **1703** defining a stop to restrict the possible angles between the lever extension arm **1602** and said handle. The upper end of the lever extension arm **1602** is profiled with a curved portion **1704** and a flat portion **1705**. The curved portion **1704** allows the angle between the extension member **1602** and the handle **1603** to be reduced from that shown in Figure **17**A, while the flat portion is configured to butt up against the stop **1703**, as shown in said Figure, to prevent the angle from

increasing further. In the present embodiment, the stop prevent the angle between the handle and the lever extension arm from increasing beyond a predetermined angle of **170** degrees. However, other predetermined angles between **150** degrees and **180** degrees are envisaged.

[0094] The lever extension member **1602** comprises a hinge member **1705**, a cylindrical tube **1706** and a socket member **1707**; the socket member itself including the socket **1701**. The ends of the cylindrical tube **1706** are rigidly secured within cylindrical holes in the hinge member **1705** and the socket member **1707** respectively by an adhesive. (The cylindrical hole in the socket member is shown in *Figure 18* as hole **1801**.)

[0095] In the present case the hinge members **1705** and **1606**, and the socket member **1707** are formed in a rigid plastics material by injection moulding, while the cylindrical tube **1706** is a length of glass fibre reinforced resin tube.

[0096] In the present embodiment the socket member **1707** comprises two parts **1708** and **1709** fixed together by a screw fastener **1711**.

[0097] In an alternative embodiment, the socket member is a single molded component.

Figure 18

[0098] The two parts **1708** and **1709** of the socket member are shown in further detail in *Figure 18*.

[0099] The lower part **1709** includes the socket which is in the form of an open sided cylinder from which extend a pair of plates **1803**. A connector part **1805** is rigidly attached to the open sided cylinder **1802**. The connector part **1805** has a flat surface **1806** from which extend a circle of teeth **1807** concentric with a hole **1808** for receiving the fastener **1711**.

[0100] The upper part **1708** of the socket member defines an axial hole **1801** for receiving the cylindrical tube **1706**. It also has a flat surface **1809** with a circle of teeth (not shown) concentric with a hole **1810** for receiving

the fastener. The teeth of the upper part **1708** are configured to interlock with the teeth **1807** of the lower part. Thus when the fastener **1711** holds the two parts **1708** and **1709** together, relative rotation of said parts is prevented. However, if, for any particular operation, the angle between the two parts requires adjustment, then the fastener may be released and the adjustment made.

Figure 19

[0101]The use of the remote installation device **1601** is illustrated by *Figures 19, 20 and 21*. The pipe stopper **101** is shown in *Figure 19* being lowered into a manhole **1901** of a sewer by means of the remote installation device **1601**. In this example the elongate handle **1603** has been unfolded to an extended configuration. A user (not shown) remains above ground level **1902** and manipulates the upper part of the handle **1603** by hand to position the pipe stopper **101** within the end of a pipe **1903**.

[0102]The angle between the handle **1603** and the lever extension arm **1602** is prevented from opening wider by the stop **1703**, and so the orientation of the extension arm and the pipe stopper **101** is under the control of the user.

Figure 20

[0103]The lower part of the remote installation device **1601** and the pipe stopper **101** is shown in *Figure 20* after the pipe stopper has been inserted into the end of the pipe **1903**. The user manipulates the handle to bring the plates **102** and **103** within the pipe such that they are perpendicular to the pipe bore, and this is assisted by the contact member **112**.

[0104]As illustrated by *Figure 20*, the angle between the extension arm **1602** and the handle **1603** allows the pipe stopper to be located within the pipe without the wall **2001** of the manhole interfering with the remote

installation device.

[0105] When the seal has been correctly positioned, the user pushes down axially along the handle **1603**, causing the angle between the lever extension arm **1602** and the handle **1603** to reduce. A reaction force from the pipe wall on the contact member **112** prevents the pipe stopper **101** from tilting out of position. Consequently, the lever **108** is rotated by the remote installation device from its first position to its second position in which the plates **102** and **103** are brought closer together, and the flexible seal **104** is radially expanded against the wall of the pipe.

Figure 21

[0106] The pipe stopper **101** and remote installation device **1601** are shown in *Figure 21* after the seal has been radially expanded against the pipe wall. Thus the pipe **1903** is sealed by the pipe stopper **101** while the user remains above ground level and avoids having to climb down into the confined space of the manhole.

[0107] When the user wishes to remove the pipe stopper, they again remain above ground level and pull axially on the handle **1603**, to return the lever to its first orientation, allowing the flexible seal to radially contract and unplug the pipe. The pipe stopper is then removed from the pipe and the manhole by further manual manipulation of the elongate handle **1603**.

[0108] In the above example the remote installation device **1601** was used in co-operation with the pipe stopper **101**. However, it may be used with other lever operated expandable pipe stoppers, such as pipe stopper **1001**.

[0109] Although, for the purposes of the above description the pipe stopper and remote installation device has been separately labelled as such, these two items in combination are also regarded as a pipe stopper.

Figures 22A and 22B

[0110] A side view and a rear view of an alternative pipe stopper **2201** is

shown in *Figures 22A and 22B* respectively. The pipe stopper **2201** is similar to pipe stopper **101**, except the lever **108** has been replaced by an elongated lever **2208**, hingedly connected to an elongate handle **2203**. The lever **2208**, like lever **108** is moulded in a plastics material with cam portions **2209** as a single unit. The lever **2208** is moulded around a stainless steel strengthening rod to which a pair of profiled plates **2220** are rigidly attached. The profiled plates form part of a hinge mechanism connecting the lever **2208** with the handle **2203**.

[0111] The handle in this case is formed from an aluminium tube having a stainless steel plate **2221** rigidly secured within its lower end. The stainless steel plate **2221** and the profiled plates **2220** each have an aligned hole through which a pivot pin **2222** extends.

[0112] The profiled plates have: a curved portion allowing the lever **2208** to pivot around the pin **2222** to reduce the angle between the lever and the handle; and a flat portion which is configured to butt up against the bottom of the handle as shown in Figure **22**A and prevent the angle from opening further. Thus the bottom of the handle, in co-operation with the flat portion of the profiled plates provides a stop.

[0113] The operation of the pipe stopper **2201** is substantially the same as the pipe stopper **101** when used in combination with the remote installation device **1601**.